

Measuring the health of the Denali National Park and Preserve ecosystem through combining multiple LTEM datasets

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How do you monitor an ecosystem?

Vegetation

Air Quality

Streams

Small Mammals

Big Mammals

Fire

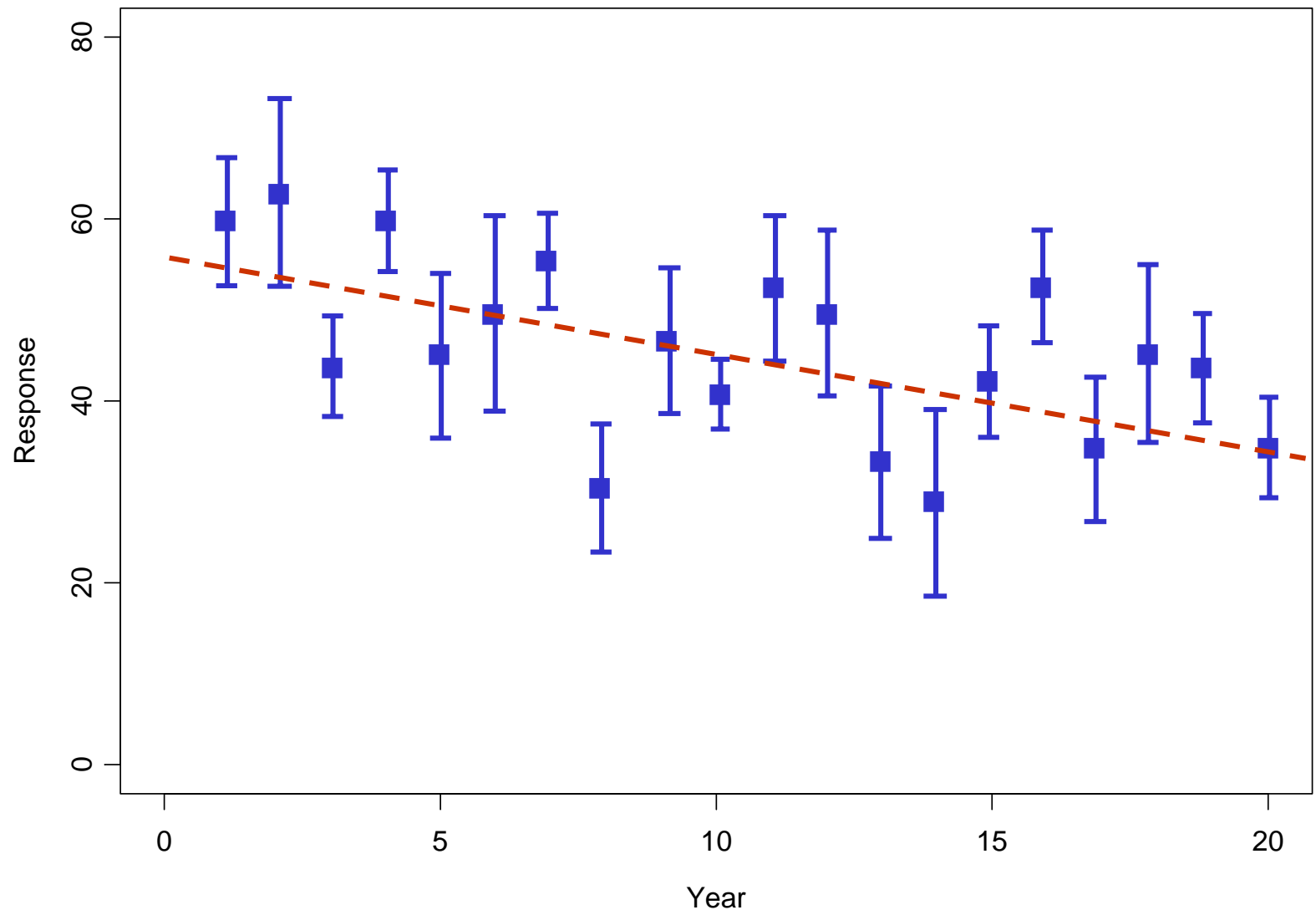
Glaciers

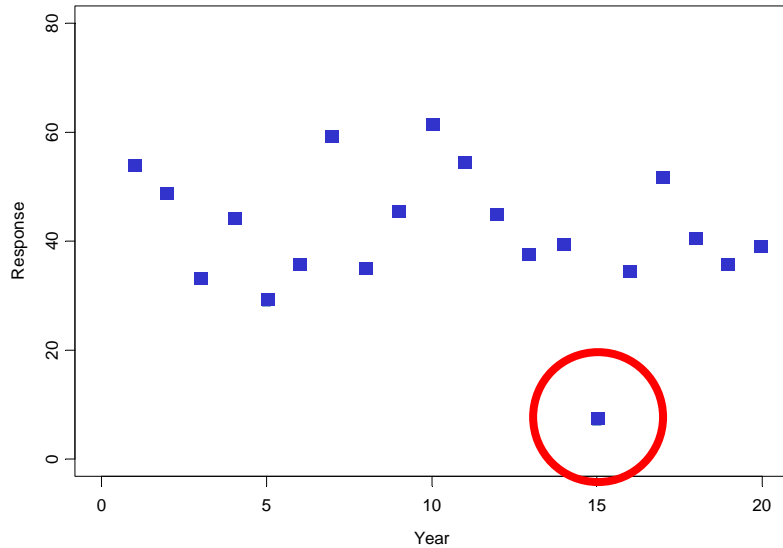
Birds

Weather

Invertebrates

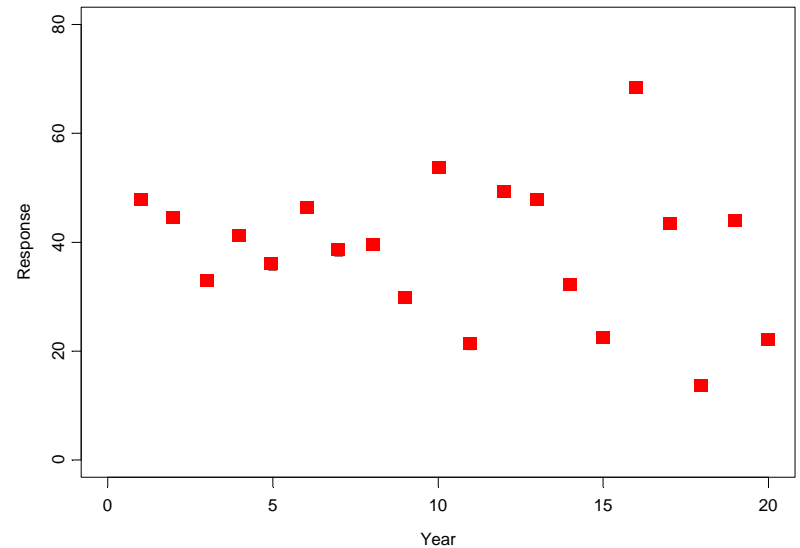
So how is the ecosystem doing?

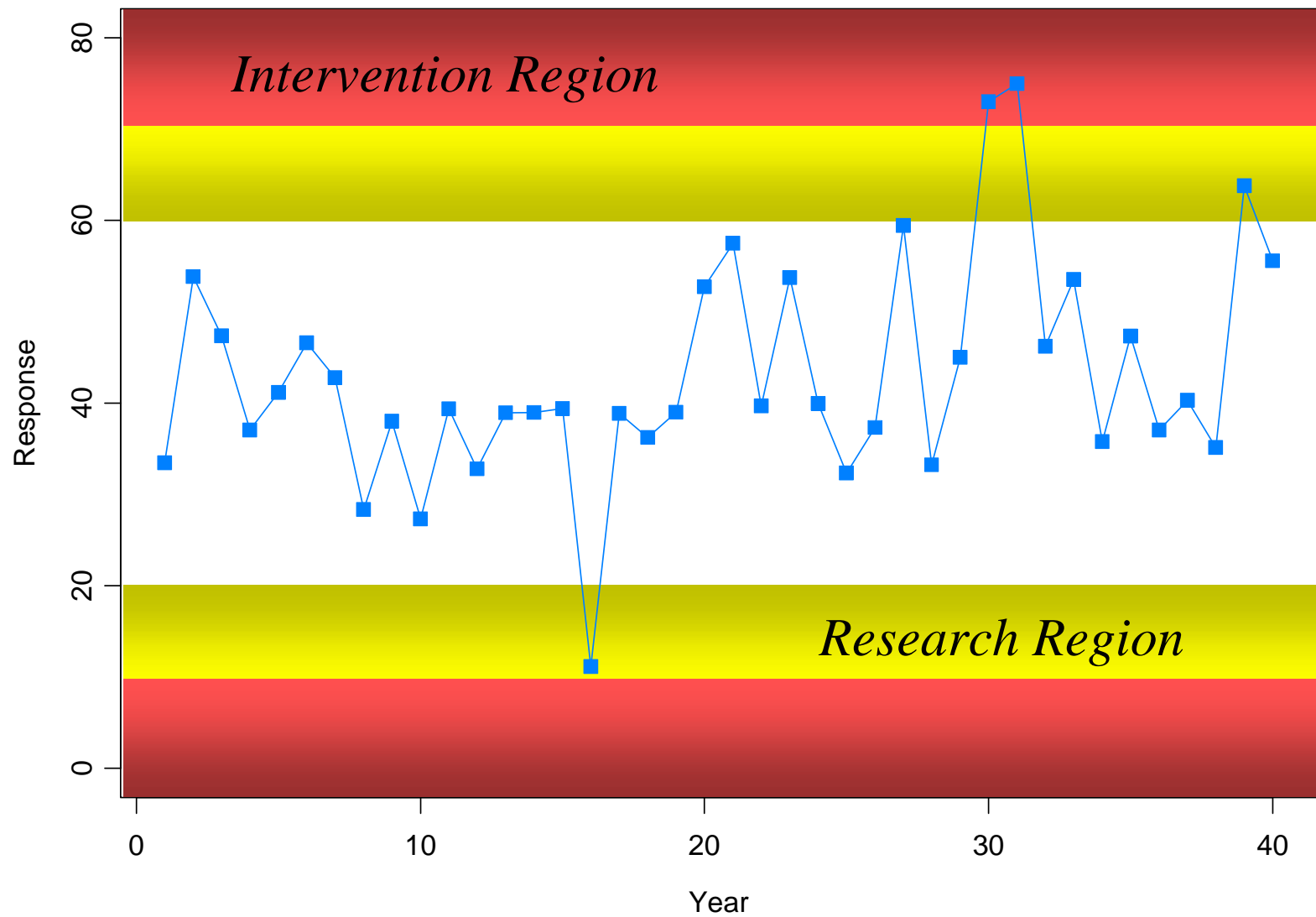




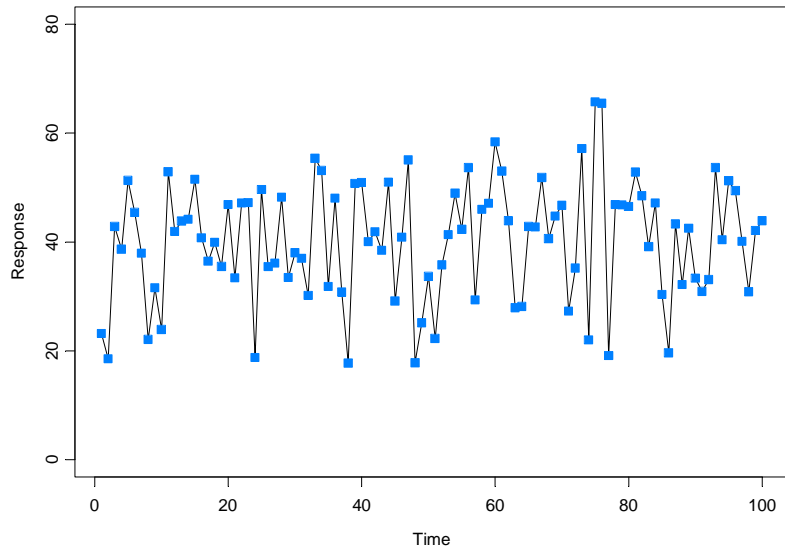
Single Aberrant Year?

Increase in
Natural Variation?

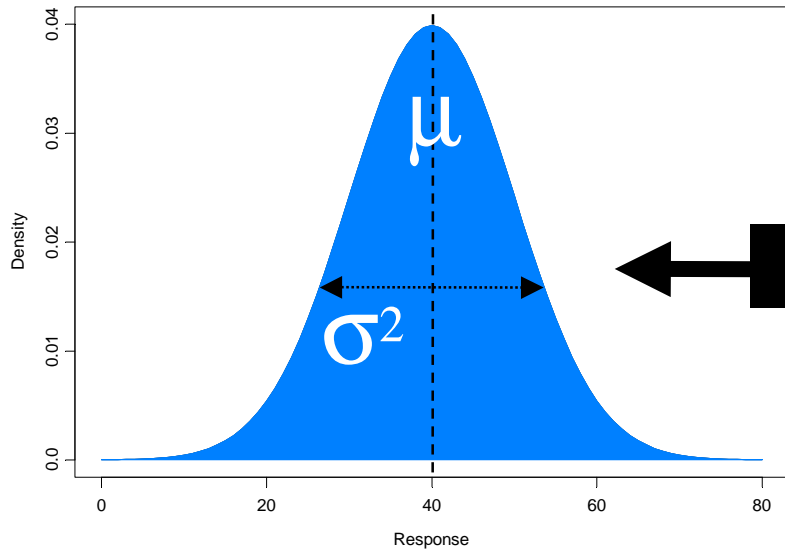
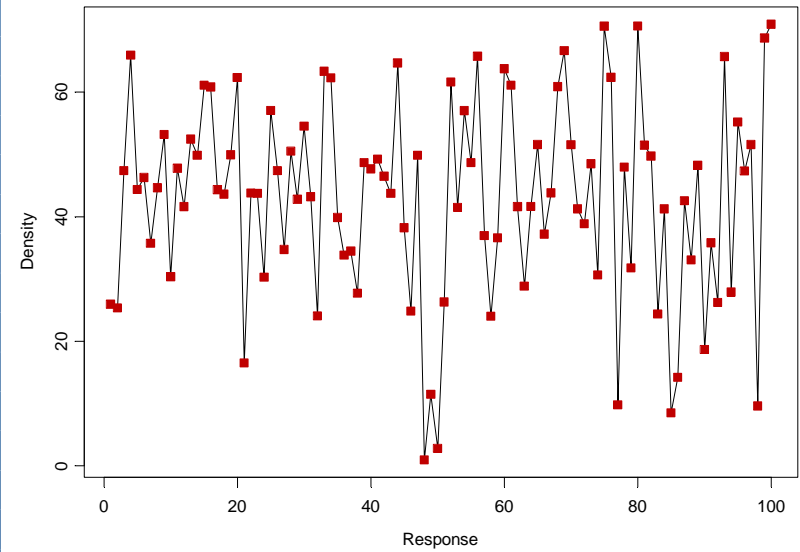




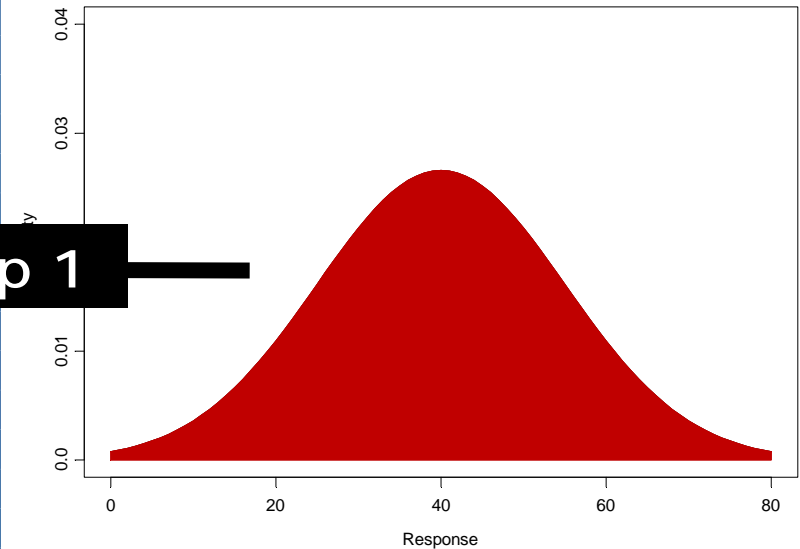
Process Variation Only



Process and Sampling Variation



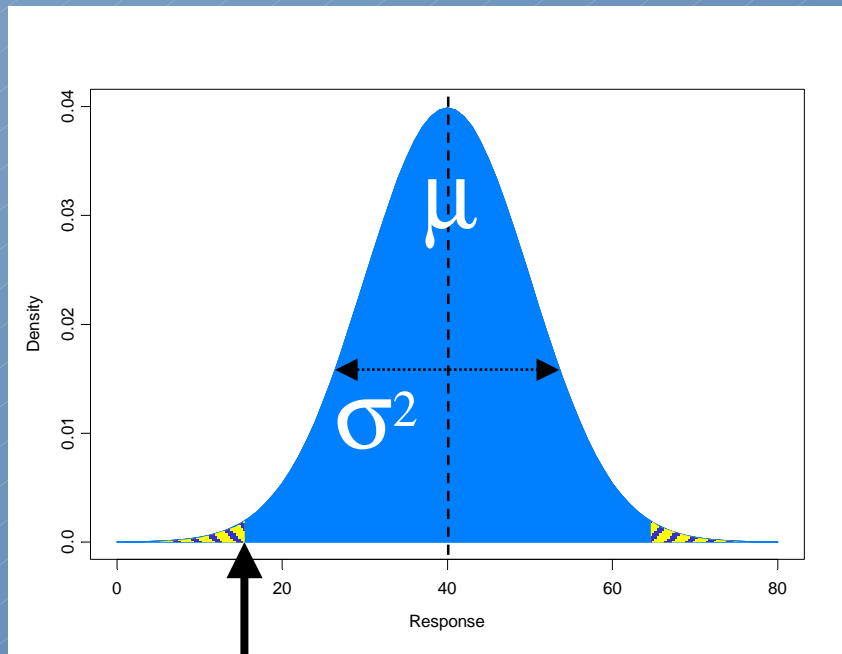
Step 1



Data Point for Year 101: X_{101} (SE)

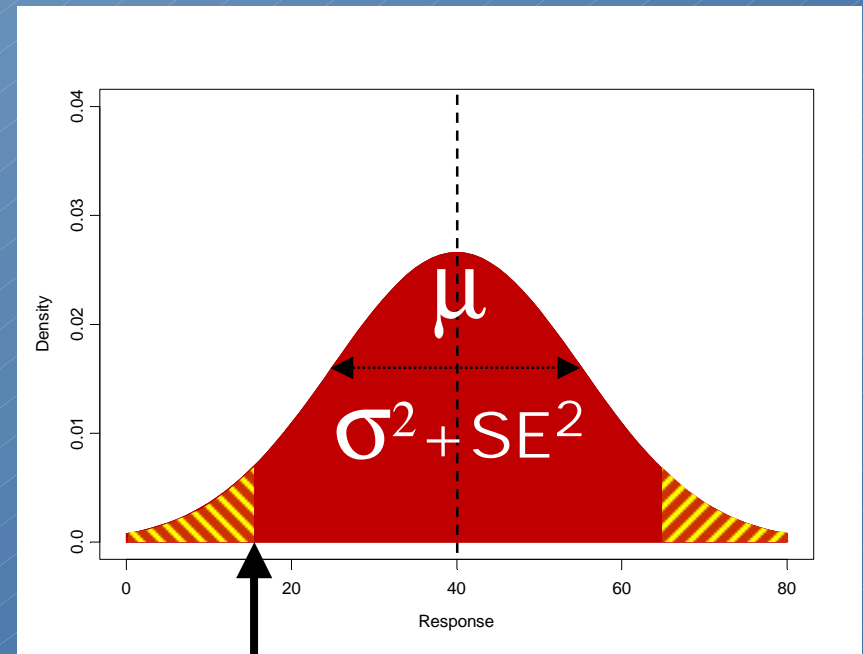
With No Sampling Error

With Sampling Error



X_{101}

Step 2

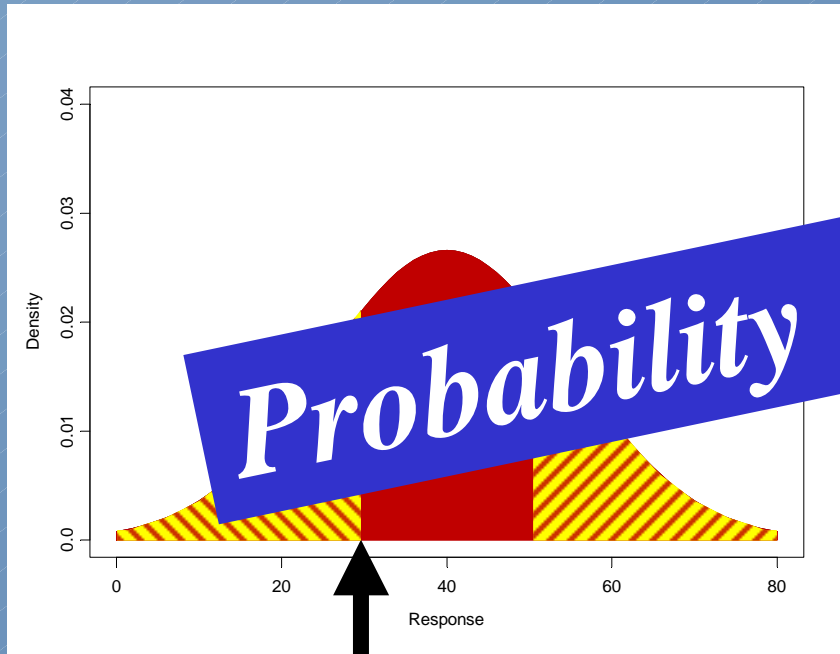


X_{101}

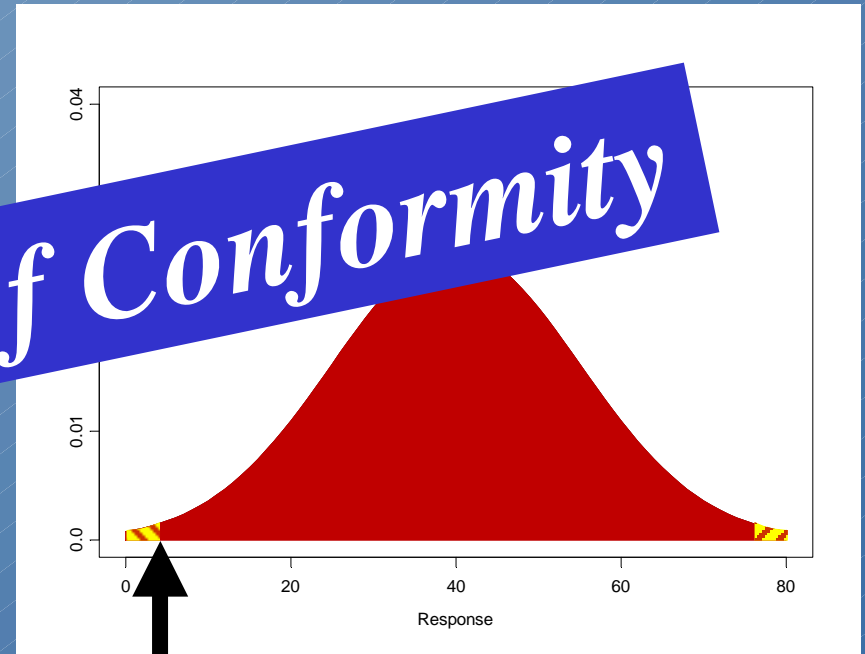
Interpreting the Probability

Large Probability

Small Probability



Large probability =
current year is typical



Small probability =
current year is unusual

Combining Multiple Probabilities

$$P_1, P_2, P_3, \dots P_n$$

$$-2 \sum_{i=1}^n \log(P_i) \sim \chi_{2n}^2$$

For Example:

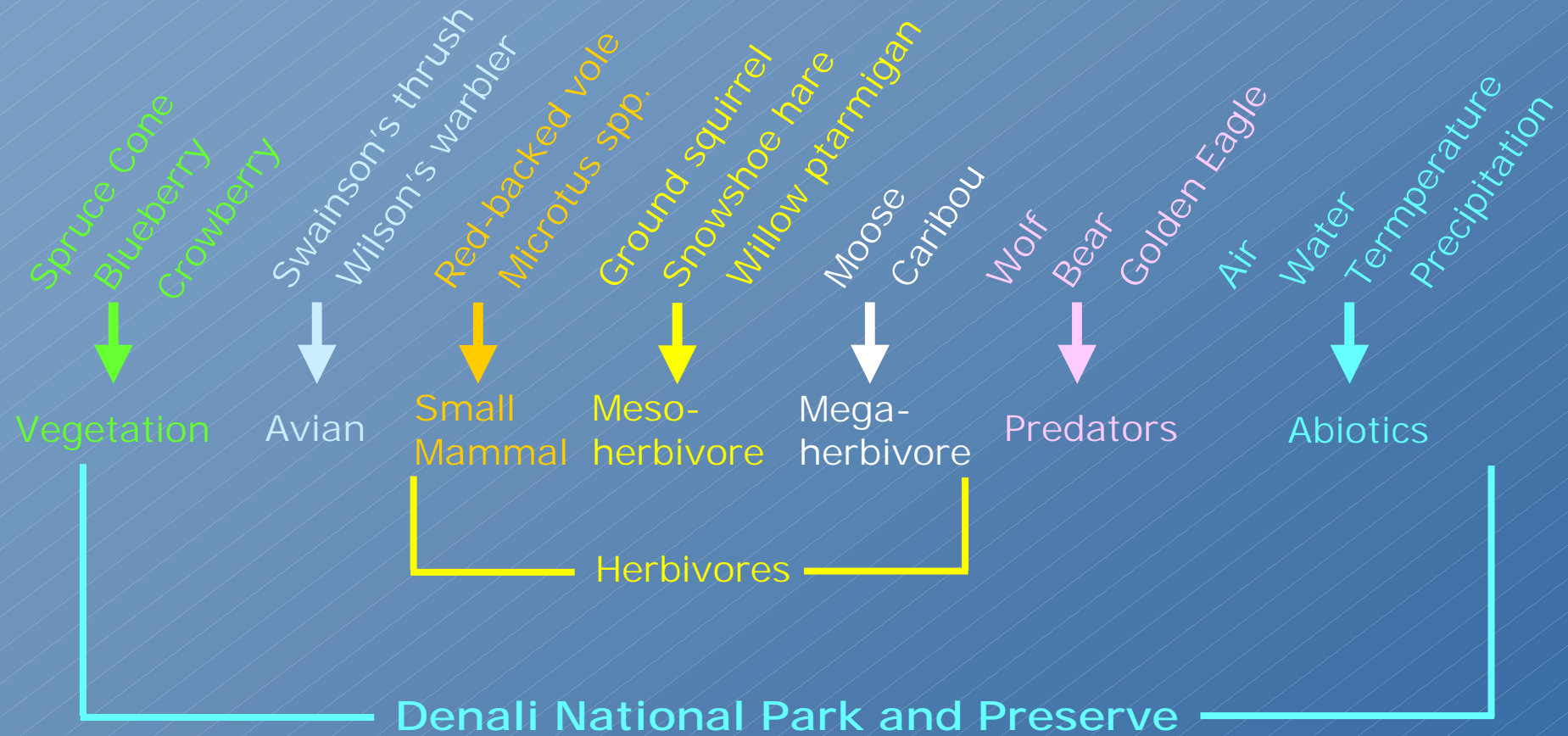
$$\left. \begin{array}{l} 0.01 \\ 0.5 \end{array} \right\} 0.031$$

$$\left. \begin{array}{l} 0.3 \\ 0.5 \end{array} \right\} 0.435$$

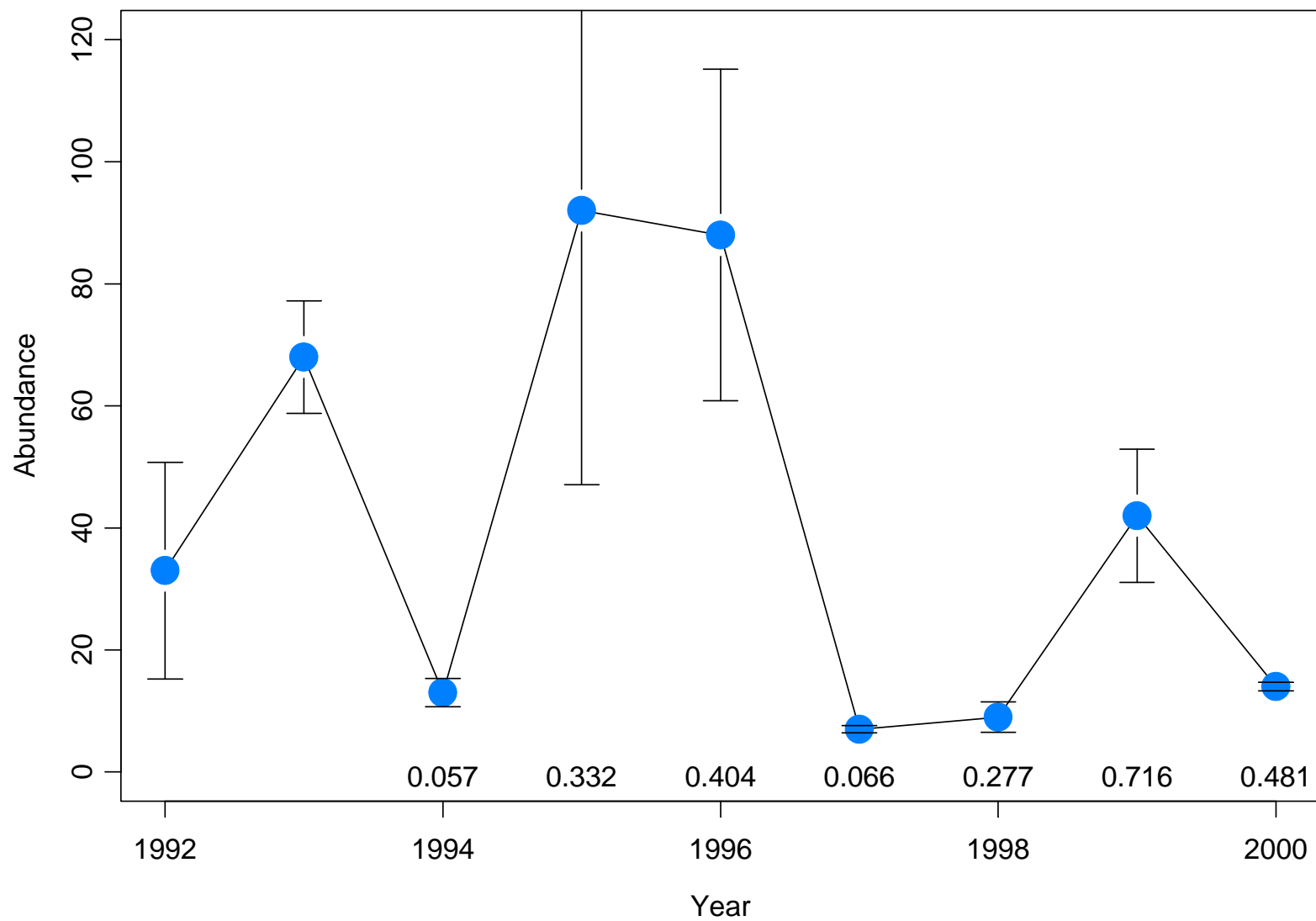
$$\left. \begin{array}{l} 0.01 \\ 0.02 \\ 0.3 \\ 0.5 \end{array} \right\} 0.0076$$

$$\left. \begin{array}{l} 0.01, 0.1, \\ 0.2, 0.25, \\ 0.3, 0.5, \\ 0.7, 0.9 \end{array} \right\} 0.079$$

Pooling Options



RF1 Clethrionomys Abundance



Conclusions

- Does not rely on detecting a systematic trend.
- Tests for conformity with the past.
- Provides a timely indication of system “health”.
- Good for detecting perturbations or change point.
- Easy to pool components to desired level.